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I, KIM MARSHALL, MANAGER EXAMINATION SUPPORT AND SALES, hereby certify that the annexed is a true copy of the Provisional specification in connection with Application No. PP 4792 for a patent by WAYNE SAINTY filed on 21 July 1998.

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day of August 1999

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PROVISIONAL SPECIFICATION

ION SOURCE

This invention is described in the following statement:

This invention relates to ion sources and in particular to those known as end Hall-effect ion sources.

Previous ion sources have had to operate at pressures of the order of 10^{-4} Torr to create breakdown of the ionisable gas that is used as the source for ion creation. Such pressures create instabilities in the activation chamber that can lead to sputtering and short circuiting. These pressures also contribute to a decreased lifetime of the filament used to create the electron beam.

The invention resides in an ion source including a cathode, an anode and an ionisation region between the cathode and the anode, means for creating a potential difference between the anode and the cathode, means for creating a magnetic field within the ionisation region and means for introducing an ionisable gas into the ionisation region at a localised area in proximity to a maximum of the magnetic field intensity.

The anode is preferably an annulus centred on the longitudinal axis of the magnetic field and the gas is introduced into a region at the centre of the anode, the region being substantially narrower than the inner diameter of the anode.

The invention further resides in an ion source including a cathode, an anode and an ionisation region between the cathode and the anode, means for creating a potential difference between the anode and the cathode, means for creating a magnetic field within the ionisation region, and means for introducing an ionisable gas into the ionisation region, wherein the surface of the anode in the region adjacent the ionisation region is of a non-oxidising electrically conductive material.

The invention further provides for an ion source including a cathode, an anode and an ionisation region between the cathode and the anode, means for creating a potential difference between the anode and the cathode, means for creating a magnetic field within the ionisation region and means for introducing an ionisable gas into the ionisation region, wherein the anode and magnetic field means are supported by a mounting base of electrically non-conductive material and the means for introducing the ionisable gas passes through the mounting base such that the ionisation region is electrically isolated from the gas introducing means.

The invention still further provides an ion source including a cathode, an anode and an ionisation region between the cathode and the anode, means for creating a potential difference between the anode and the cathode, means for creating a magnetic field within the ionisation region and means for introducing an ionisable gas into the ionisation region, wherein the cathode and anode are contained in an electrically conductive shield plate.

The invention will now be described by way of example only with reference to the drawings in which:

Figure 1 is a cross-sectional elevation of the ion source according to the invention.

Figure 2 is a plan view of the ion source in figure 1.

Figure 3 is a cross-sectional view of a preferred form of the invention.

Figures 1 and 2 show an ion source generally at 10 having a cathode wire 11 and an anode 12. The anode 12 is an annulus having an inner surface 35 sloping outwards in the direction of the cathode. Between the cathode 11 and the anode 12 is an ionisation region 13. The cathode wire 11 is suspended above the anode by two mounting pins 20 that are held by, and in electric isolation from a shield plate 30. The

shield plate 30 extends from a point lower than the anode 12 to a point above the cathode 11 and is preferably maintained at earth potential to shield the anode and the cathode from external fields.

The anode 12 is preferably made of stainless steel but has a coating of a non-oxidising electrically conductive material, for example TiN, on the inner surface 35. The surface coating prevents the anode from oxidising and creating a dielectric layer between the anode and cathode, which reduces the anode potential.

A magnet 14 is disposed outside the ionisation region 13 but adjacent anode 12. The magnet 14 may be a permanent magnet or an electromagnet. Preferably the magnet is a high flux rare earth magnet such as a Nd Fe B magnet. The axis of the magnet is aligned with the axis of the anode such that the centre of the anode is within the ionisation region 13 and is a point of maximum magnetic field intensity.

The ionisable gas, for example oxygen, nitrogen or argon is introduced into the plasma activation region via gas feed line 22. The feed line 22 terminates at an outlet 15. The outlet 15 is preferably a curved perforated plate such that the gas is introduced into the plasma region 13 in a substantially random direction. The outlet 15 is disposed within the ionisation region 13 at or near the point of maximum magnetic field intensity. The pressure at the outlet 15 is relatively high but decreases rapidly with distance from the outlet. The background pressure can therefore be lower than in prior art ion sources. The size of the outlet 15 will depend on such factors as the gas flow rate, the magnetic field strength, the background pressure, the electron beam current and the electron energy, and these factors can be varied provided ionisation of the gas is still achieved. However, if the outlet 15 is broadened the local pressure around the outlet is decreased which decreases the level of ionisation of the gas and also the sensitivity of the device. In addition, the likelihood of arcing and sputtering in other areas of the device is increased. Therefore, the width of the outlet 15 is preferably approximately 50% of the inner diameter of the anode 12 or less.

Electrons omitted from the cathode are influenced by the anode potential and the magnetic field and tend towards the point at which the gas is being introduced. This focusing of the electron beam into the region of high pressure increases the level of ionisation of the gas and provides a device of high sensitivity.

The plate 15 is preferably magnetically permeable and is maintained substantially at the anode potential. This will concentrate both the magnetic and electric fields in this region which leads to an increased electron flux from the cathode and higher levels of ionisation of the gas.

Because the ion source 10 operates at a low background pressure the anode and cathode can be in closer proximity than in previous devices. Figure 3 shows a preferred form of the invention where the inner edge 31 of the plasma shield 30 extends towards the anode 12. Preferably the inner edge 31 of the shield 30 is disposed outside a projection of the inner surface 35 of the anode 12. The extended edge 31 has a flange 32 that surrounds an upper portion of the anode 12. The purpose of the flange 32 is to prevent gas entering the region 40 where the gas could be ionised and cause arcing. To further prevent this a seal, preferably of an elastomer material, can be disposed between the flange 32 and an upper portion of the anode 12.

The anode 12 preferably has disposed within it a channel 53 in communication with a fluid conjugate 55 that provides water to cool the anode. The channel 53 preferably extends into the outlet 15.

The anode 12, gas outlet 15 and shield 30 are mounted on a non conductive mounting base 50 through which extends the gas feed line 22 and fluid conjugate 55. The magnet 14 is housed within the base such that the external pole is exposed. The mounting base 50 has a conduit 58 that connects the gas feed line 22 to the outlet 15 such that no electrical connection can be made between the outlet 15 and the gas feed line 22. The mounting base 50 has a similar conduit for connecting the water feed line 55 to the channel 53. The gas and water feed line preferably screw into the mounting

base 50. The mounting base 50 is preferably made of glass filled polytetrafluoroethylene.

The anode, cathode and shield are preferably of very low magnetic permeability. This provides two effects. Firstly external fields are shielded from influencing the behaviour of the electrons and ions within the ion source. Secondly the magnetic field due to the magnet is concentrated through the outlet plate and disperses entirely through the plasma activation region.

Dated this 21st day of July, 1998.

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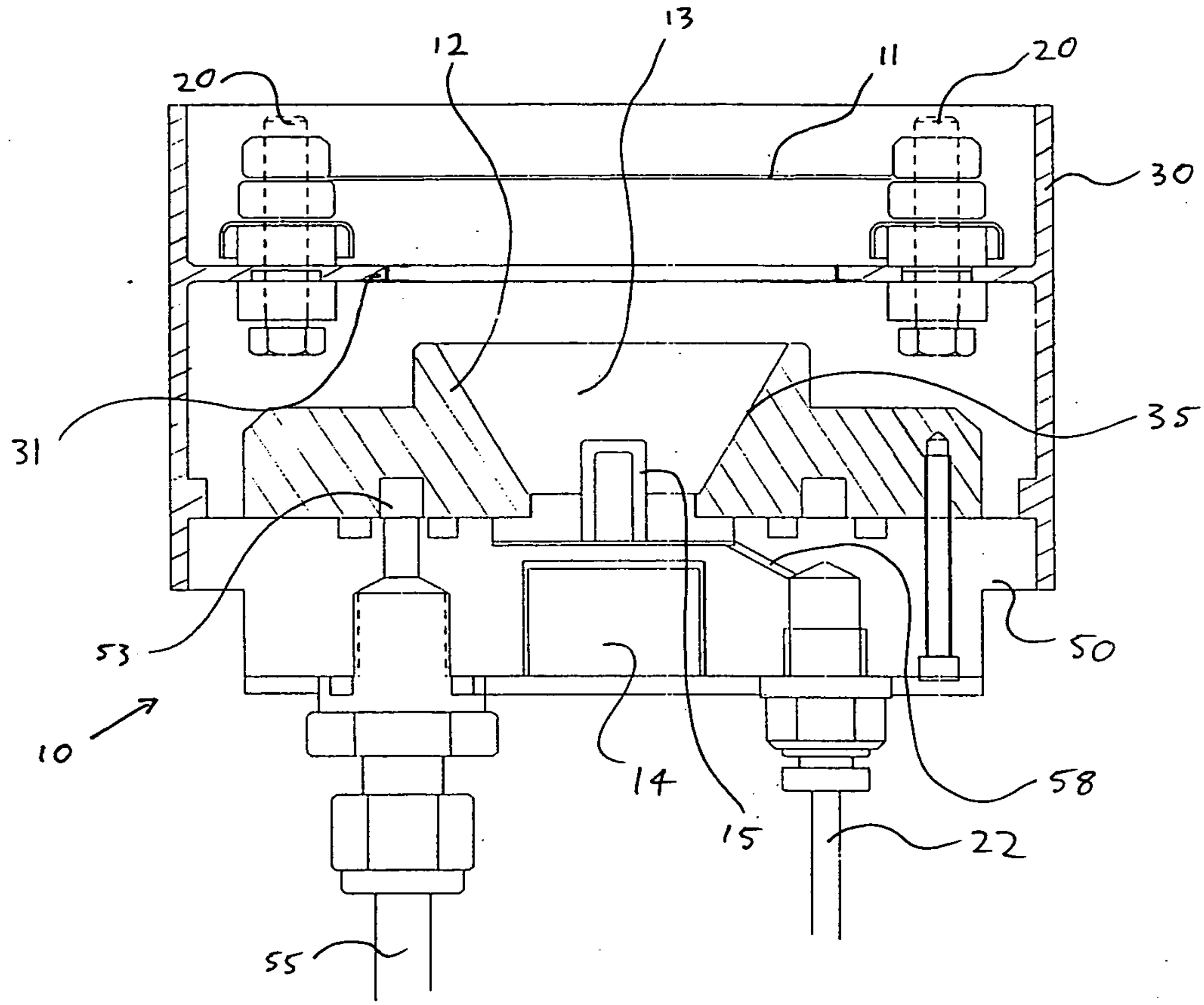

Figure 1

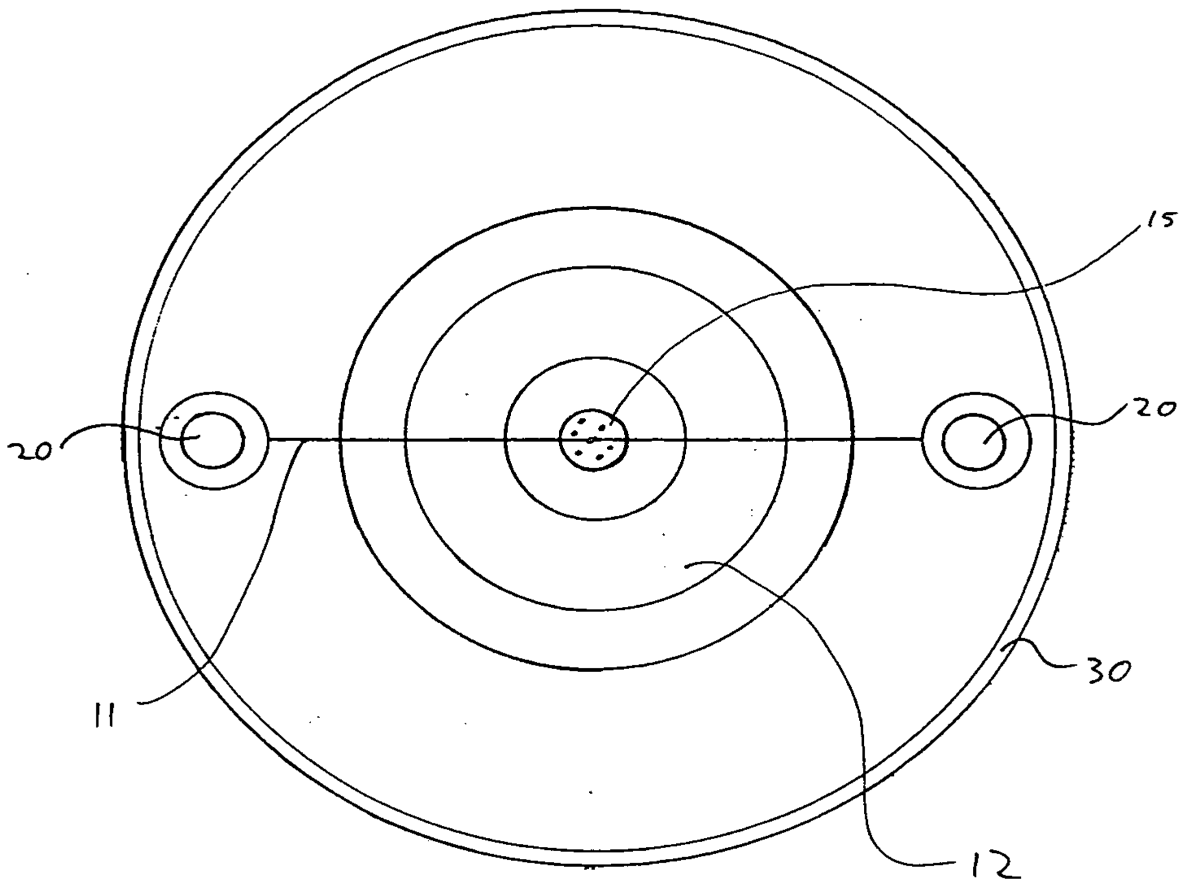

Figure 2

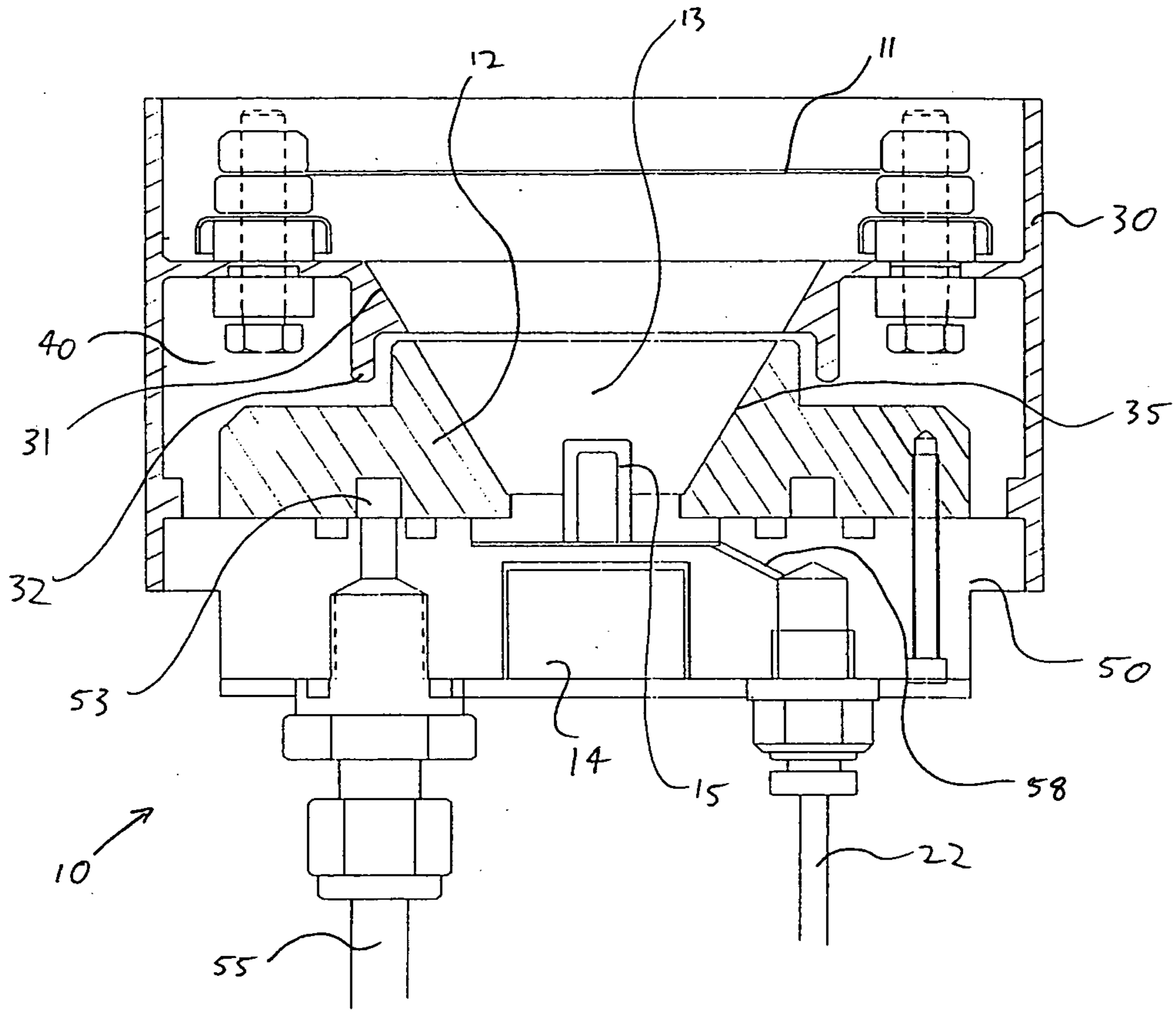

Figure 3